

SPAWNING CHRONOLOGY AND LARVAL EMERGENCE OF JUNE SUCKER (*CHASMISTES LIORUS*)

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ABSTRACT.—June sucker (*Chasmistes liorus*) spawned in the Provo River, Utah, over a 2-wk period in early June during both 1987 and 1988. Emergent larvae emigrated from the river to Utah Lake over a 2- to 3-wk period. Drift into the lake peaked between 1200 and 0400. During daylight hours, emergent larvae tended to occur in pools. Peak emergence of larval drift was approximately 1.2 larvae/m³ during late June in 1987 and 1988. Recruitment failure of June sucker is not due to reproductive failure.

Key words: June sucker; *Chasmistes liorus*, spawning, larvae, habitat, drift, emergence, river.

The June sucker (*Chasmistes liorus*) is one of three contemporary species of the genus *Chasmistes* (Miller and Smith 1981) and is endemic to Utah Lake, a 38,000-ha remnant of prehistoric Lake Bonneville. Once June sucker numbered in the millions (Jordan 1891) and were one of the most abundant fishes in Utah Lake. During the last century population size of June sucker declined drastically. In a survey of Utah Lake fishes, less than 0.4% of fish collected were June sucker (Radant and Sakaguchi 1981). The population of June sucker has been estimated to be <1000 adults and is listed on the federal register as an endangered species (U.S. Fish and Wildlife Service 1986). Suspected factors contributing to the decline of this species include water loss to irrigation and drought, degradation of water quality, and negative interactions with nonnative fishes (Radant and Hickman 1984). Reduction of water quantity and quality impacted both the lake and spawning tributaries.

The direct cause of decline in the June sucker population has been lack of recruitment (Sigler et al. 1985). In a survey of Utah Lake, Radant and Sakaguchi (1981) did not capture any June sucker <400 mm total length. Scoppettone (1988) reported that June sucker may live to be 42 years of age; thus, in the absence of recruitment, senescent individuals would dominate the population. None of the 18 fish he examined was younger than 20 years of age.

June sucker have been described as spawning on gravel cobble substrate in relatively high-velocity habitats (Radant and Hickman 1984). Sex products are broadcast over the substrate, and eggs are adhesive to the substrate (Shirley 1983, Radant and Hickman 1984). Although information on spawning behavior and larval morphology (Shirley 1983, Snyder and Muth 1988) exists, no information is available on spawning success of the June sucker. Because natality is a vital element of recruitment, information on spawning success is important in understanding declining abundance of this species. The objectives of our study were to (1) estimate timing and magnitude of downstream drift of emergent June sucker larvae and (2) describe habitats occupied by larval June sucker in the Provo River.

METHODS

Drift Sampling

Drift netting was conducted in the lower Provo River to capture emergent larvae during the 1987 and 1988 spawning periods. Netting began 1 June 1987 and terminated when larvae ceased to appear in collections. Five drift nets, each with a mouth size of 30 × 45 cm and a mesh size of 560 microns, were placed at a single site about 3 km upstream of Utah Lake, immediately downstream of the lowermost observed June sucker spawning activity. Nets

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were anchored with 0.64-cm-diameter rebar along a single transect perpendicular to the channel. When depth permitted, nets were placed alternately at the surface and bottom. In 1988, drift netting using the same sampling scheme began 6 June. The netting site was moved about 50 m downstream of the 1987 site because of physical changes in the channel. Only four nets were used during 1988.

Nets were set on alternate days (MWF) each week. Each 24-h day was divided into six 4-h periods, and drift was sampled continuously during the middle 1.5 h of each. Starting times were 1315, 1715, 2115, 0115, 0515, and 0915 h. Drift from each net was rinsed, placed in watertight plastic bags, and preserved in 5% buffered formalin; 420 samples were taken.

Velocity (10-sec average) through each net and water depth were measured before and after each set. Volume sampled was estimated by multiplying the average of the two velocity measurements by time sampled and area of the net opening. Water temperature was recorded during each 4-h interval. All samples were sorted for eggs and larvae, which were identified to species (Snyder and Muth 1988), counted, and measured to the nearest 0.1 mm (total length).

Habitat Sampling

Fishes in a 2.25-km section of the lower Provo River were sampled during the 1988 spawning season to determine larval habitat use. Eighty-four transects, about 27 m apart and perpendicular to the thalweg, were established from aerial photographs of the river. Three samples were taken along each transect, one near each shore and one in the middle of the river. Samples were collected with a 1-m² bag seine with a 560-micron mesh. Substrate in a 1-m² area immediately in front of the seine was mechanically stirred at each sampling site, and the seine was quickly pulled through. Samples were taken only during daylight hours.

Habitat types were described and widths measured along each transect using a modification of Bisson et al. (1982). All fish collected were placed in plastic containers and preserved in 5% buffered formalin. Larvae were identified to species, measured to the nearest 0.1 mm (total length), and counted.

Analysis

Means for egg and larval density in the drift were determined for daily and 4-h periods. Standard deviations were calculated from daily means among periods and for periods with days as replicates. Drift densities were estimated by dividing eggs and larvae collected during each sampling period by water volume passing through drift nets. Daily estimates were determined by computing the means of all six time periods. Estimates of total larvae on the peak drift date were determined by averaging discharge recorded at the Provo City gauge station (USGS) on both days samples were made and multiplying the volume estimate by daily mean larval density.

Because of the few sites in which June sucker larvae were present, habitats were grouped into pool and nonpool categories. Chi-square analysis was used to test the significance of differences in the incidence of larval June sucker in pool and nonpool habitats, and odds ratio analysis (Fienberg 1980) was used to quantify the magnitude of differences observed.

RESULTS

Drift

Spawning, as defined by egg drift, was higher on 3–4 June 1987 and peaked on 6–7 June 1988 (Figs. 1, 2). A malfunction of the velocity meter on 6 and 8 June 1988 prevented accurate estimation of egg and larval concentrations. However, absolute numbers of eggs captured on 7 June (0.007 eggs/sec) and 8 June (0.005 eggs/sec) exceeded those caught on 11 June (0.0007 eggs/sec). Average river temperatures during the spawning period were 13–14°C in 1987 and 12–17°C in 1988. Spawning occurred over a relatively short time; eggs were collected for 1 wk in 1987 and 11 d in 1988. Spawning duration was probably longer in both years than shown in Figures 1 and 2 because eggs were already present in the river when sampling began. However, collections from both years suggested that June sucker spawning activity does not last more than 2 wk, with the greatest number of eggs spawned within a 3- (1987) to 5-d (1988) period.

Density of egg drift was variable and showed no diel pattern (Fig. 3). Thus, either fish were spawning in both light and dark hours or eggs were being randomly dislodged from the

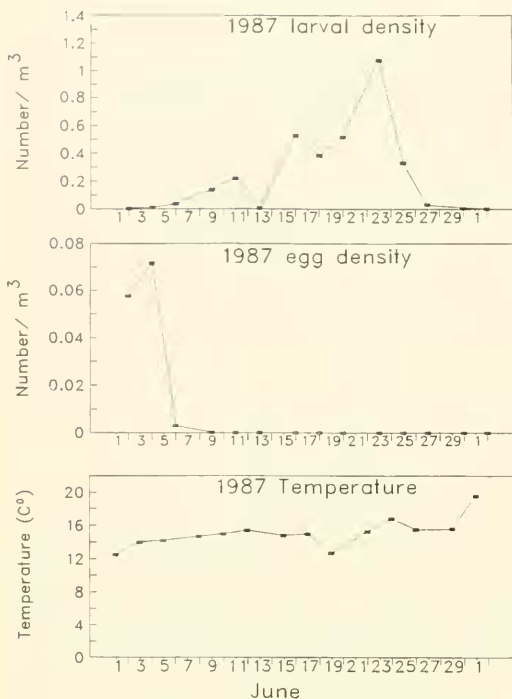


Fig. 1. Drift rates of June sucker larvae and eggs, and daily average temperature collected from the Provo River, Utah, in June 1987.

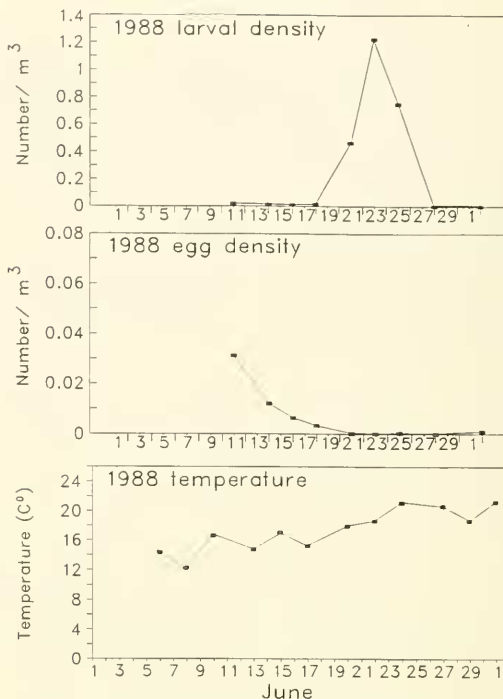


Fig. 2. Drift rates of June sucker larvae and eggs, and daily average temperature collected from the Provo River, Utah, in June 1988.

substrate throughout the 24-h period. During drift netting operations June sucker were observed spawning during both day and night.

Larval June sucker first appeared in the drift on 3 June 1987 and 6 June 1988 (Fig. 1). Although velocity error precluded absolute measurement until after 10 June, few larvae were collected until 20–21 June. Peak densities of larvae in the drift occurred on 22–23 June 1987 and 22–23 June 1988. Minimum estimates of the time between egg deposition and swim-up, measured as the period between peak egg drift and peak larval drift, were 19 d in 1987 and 16 d in 1988. The difference in incubation time between years is probably due to warmer river temperature in 1988 (15–19°C) than in 1987 (12–16°C). Drift of June sucker larvae continued for about 3 wk during both study years. All June sucker larvae collected were identified as either proto- or mesolarvae.

A distinct daily pattern of larval drift density was observed, with most larvae captured between 2000 and 0400 h (Fig. 4). Few larvae were collected in drift nets during daylight. Peak daily estimates of drifting June sucker

larvae in the Provo River were approximately 60,200 in 1987 and 73,000 in 1988.

Habitat Use

A total of 57 June sucker larvae were collected in 7 of 115 collections. Incidence of larvae in pool-type habitats was different from nonpool habitats ($X^2 = 7.04$, $.05 = 5.99$). June sucker larvae were 7.5 times more likely to be found in pool than nonpool habitats during daylight hours.

DISCUSSION

Shirley (1983) reported June sucker spawning in mid-June when mean water temperature was between 11 and 13°C. Similar observations were made by Radant and Hickman (1984) and Radant and Sakaguchi (1981). Radant and Hickman (1984) also observed a short spawning period that lasted only 5–8 d. The cui-ui (*Chasmistes cujus*) also spawns during a brief period: males occupying the Truckee River, Nevada, 6.5–16.5 d and females 4.0–10.5 d (Scoppettone et al. 1986). Temperatures of the Truckee River during cui-ui spawning

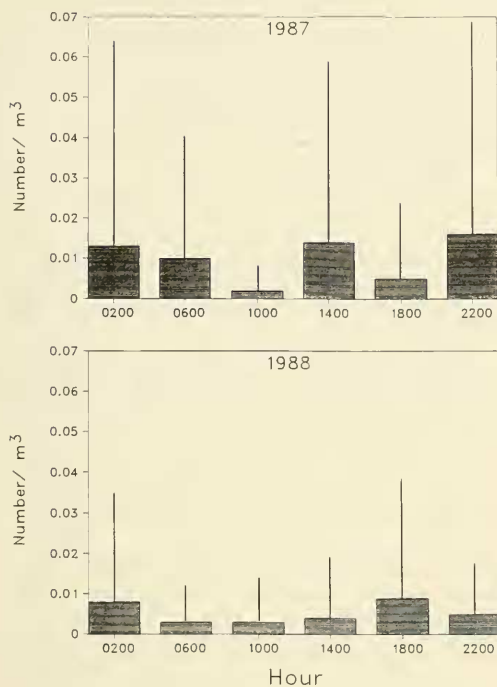


Fig. 3. Diel drift rate of June sucker eggs collected in the Provo River, Utah, in June 1987 and 1988. Vertical bars represent one standard deviation.

ranged from 12 to 15°C. Cui-ui spawned between 2000 and 0600 h during a 3-d period (Scoppettone et al. 1981), whereas egg drift densities of June sucker and observation during both 1987 and 1988 indicated spawning occurred during all hours of the day and night. Scoppettone et al. (1983) reported peak emergence of cui-ui larvae occurred 14 d after peak spawning. Differences between peak June sucker spawning and peak emergence varied between years, from 19 d in 1987 (temperature range 13–15°C) to 16 d in 1988 (temperature range 17–19°C).

Like cui-ui (Scoppettone et al. 1986) and other catostomids (Geen et al. 1966), June sucker larvae emigrate from spawning tributary into receiving lake shortly after emergence. Drift activity of larval June suckers was nearly identical to that of cui-ui, most drift occurring just prior to 0000 and declining to negligible numbers by 0600. In spite of large numbers of larvae captured in the drift, relatively few were captured by seining. Those larvae seined during daylight hours were mostly in pool-type habitats, as reported by both Radant and Hickman (1984) and Shirley (1983). Few, if any, larvae remained in the

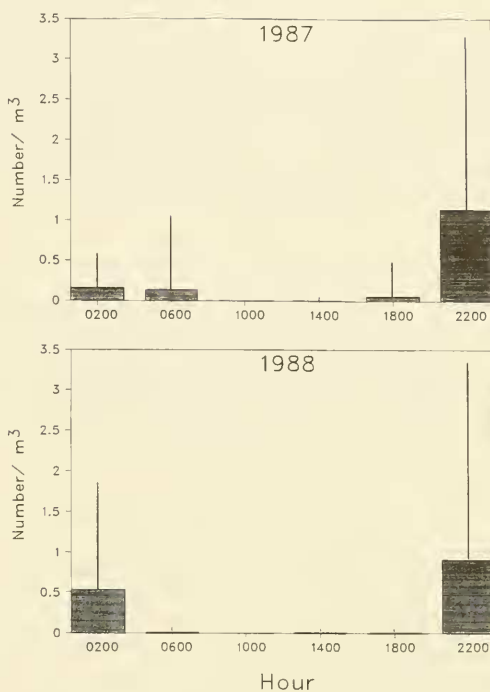


Fig. 4. Diel drift rate of June sucker larvae collected in the Provo River, Utah, in June 1987 and 1988. Vertical bars represent one standard deviation.

Provo River for an extended time. Most larvae drifted out of the Provo River during a 2- to 3-wk period, whereas cui-ui were reported to drift through the Truckee River for nearly 30 d. Differences between the two species in duration of larval emergence and drift may result from a larger cui-ui spawning population.

Although the abundant numbers of June sucker larvae produced in 1987 and 1988 are surely less than historic numbers, substantial numbers of larvae drifted into Utah Lake. Sigler et al. (1985) suggested the decline in the Pyramid Lake cui-ui population was due to failure of natural reproduction. Based on the large numbers of larvae captured in the drift, despite the relatively small population of adult June sucker, insufficient spawning or emergent success seemingly did not limit recruitment to Utah Lake. Instead, factors affecting survival after larval emergence, such as nonnative predators, seem likely.

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